Whole-Stream Response to Nitrate Loading in Three Streams Draining Agricultural Landscapes

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Physical, chemical, hydrologic, and biologic factors affecting nitrate (NO_3^-) removal were evaluated in three agricultural streams draining orchard/dairy and row crop settings. Using 3-d "snapshots" during biotically active periods, we estimated reach level NO_3^- sources, NO_3^- mass balance, in-stream processing (nitrification, denitrification, and NO_3^- uptake), and NO_3^- retention potential associated with surface water transport and ground water discharge. Ground water contributed 5 to 11% to stream discharge along the study reaches and 8 to 42% of gross NO_3^- input. Streambed processes potentially reduced 45 to 75% of ground water NO_3^- before discharge to surface water. In all streams, transient storage was of little importance for surface water NO_3^- retention. Estimated nitrification (1.6–4.4 mg N m^{-2} h^{-1}) and unamended denitrification rates (2.0–16.3 mg N m^{-2} h^{-1}) in sediment slurries were high relative to pristine streams. Denitrification of NO_3^- was largely independent of nitrification because both stream and ground water were sources of NO_3^-. Unamended denitrification rates extrapolated to the reach-scale accounted for <5% of NO_3^- exported from the reaches minimally reducing downstream loads. Nitrate retention as a percentage of gross NO_3^- inputs was >30% in an organic-poor, autotrophic stream with the lowest denitrification potentials and highest benthic chlorophyll ***a***, photosynthesis/respiration ratio, pH, dissolved oxygen, and diurnal NO_3^- variation. Biotic processing potentially removed 75% of ground water NO_3^- at this site, suggesting an important role for photosynthetic assimilation of ground water NO_3^- relative to subsurface denitrification as water passed directly through benthic diatom beds.